

Northwest Woodlands

A Publication of the Oregon Small Woodlands, Washington Farm Forestry, Idaho Forest Owners & Montana Forest Owners Associations

INTEGRATED PEST MANAGEMENT

See the Forest and the Trees

**When Pesticides are
the Best Option**

**Swept Away by
Scotch Broom?**

An Unusual Wood Borer



**NEXT ISSUE . . .
Logging 1.0**

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Parasitic wasps—such as this Braconid—and flies provide excellent natural control for various insect pests, such as bark beetle larvae and caterpillars. This type of parasitoid lays eggs in their host. The parasites feed and develop, killing their host before emerging from cocoons on the host. Photos courtesy: Christine Buhl

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BY CHRISTINE BUHL

14 SUCCESSFUL PESTICIDE APPLICATIONS IN THE FOREST

For a variety of reasons, careful consideration of IPM options often leads to a decision to apply pesticides. In the Pacific Northwest, application of pesticides on forestland is increasingly scrutinized and, in some places, is being banned. It is incumbent on each forestland owner and manager to carefully consider and follow these best management practices to minimize the harmful effects of our pest control activities.

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16 DON'T GET SWEEPED AWAY BY SCOTCH BROOM: USING THE BEST MANAGEMENT OPTIONS

A common noxious weed in the Pacific Northwest, Scotch broom can shade out desirable native plants, reduce forage for livestock and wildlife, add woody biomass (fuel), cause significant competition in young plantations and even change soil chemistry for years after the invader has been removed from a site.

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22 IPM FOR THE FLATHEADED FIR BORER: A MAJOR FOREST PEST IN SOUTHERN OREGON

The flatheaded fir borer is a pest in forests across North America, including hot, dry sites in southwest Oregon. The primary target is green, healthy Douglas-fir on droughty, tough sites, but this insect will also attack western larch and true firs. IPM options lean toward identification of high-risk stands and minimizing mortality ahead of an outbreak.

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MIKE CHRISTIANSON



Managing the Douglas-fir Beetle

The Douglas-fir beetle is a good candidate for implementing integrated pest management (IPM) techniques. Epidemics, though usually short-lived, may devastate susceptible stands before subsiding. If an outbreak occurs, forest conditions can favor the beetles. It is best to be ready before the beetle visits your forest. This hit home for me as there are several Douglas-fir beetle outbreaks nearby!

Spraying a chemical insecticide on the bole of a tree is not practical for larger stands. There are, however, other IPM techniques which can deter the Douglas-fir beetle.

Manipulate the stand. The denser the stand, the higher the susceptibility to beetle attack. Attacks are most successful on trees that are mature or overmature, the largest in diameter and found in densely stocked stands. Any method that will reduce stocking, percentage of Douglas-fir, or average stand age or size will produce stand conditions less favorable to the beetle. It is best to thin your forest and have a mixture of dominant and co-dominant trees.

Take care of stand disturbances. The recent fires in Montana have left many trees scorched. These trees, along with damage from windthrow, snow breakage or other weather-related phenomena, are attractive to the beetle. Trees defoliated by the western spruce budworm are also ripe for the Douglas-fir beetle. Timely salvage of down, damaged or severely weakened Douglas-fir is a means of preventing beetle outbreak.

Fell trap trees. Douglas-fir beetles prefer freshly downed trees over stand-

ing trees, so a trap-tree program can be useful in suppressing beetle populations. Trap trees are used to lure beetles into felled trees that will then be removed; thus, sparing the nearby trees. Fell three to five trees with diameters of 15 inches or larger by April 1. Drop the trees in the shade and do not limb or buck them. Leave the trap trees on site until mid-July to attract beetles throughout their flight period. Remove the trap trees as soon as practical, but before the following April 1. Trap trees may not be practical in large stands.

Use pheromones. The anti-aggregation pheromone MCH was studied in the 1970s and found to be effective in reducing the impact of Douglas-fir beetles. MCH has been available to the public since 2000. It can be used to protect a few highly valued trees, or a larger number of trees (given much money and effort). MCH is available in bubble caps of single strength and double strength. To protect a single tree, use two bubble caps. For a larger area, use 30 single-strength bubble caps per acre, or space them at 38-foot intervals. If using double-strength, space them at 54-foot intervals. Staple them on the north side of the tree, as high as you can reach, by the third week in April. The pheromone puts out a "no vacancy" alert to incoming beetles, causing the beetles to go elsewhere. Reapply yearly as long as the threat exists.

Some of the above data came from Montana DNRC, to which I give thanks. ■



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PRESIDENT'S MESSAGE



PATTI PLAYFAIR



Bugs and Crud and Firestorms... Oh My!

On Tuesday, November 7, the Washington Forest Practices Board (FPB-the body that writes Forest Practices Rules) visited eastern Washington. I KNOW! This is the equivalent of seeing rainbow unicorns on Main Street. To set the scene: We had 6 to 8 inches of new snow, it was cold and overcast, and everyone was shivering. Remarkably, some folks remained engaged and learned a little about eastside forest conditions. The themes of the field tour were tribal cultural resource concerns (presented by the Kalispel Tribe of Indians), future water-typing methodologies (DNR), pesticide use in forestry (Hancock Natural Resource Group) and small forestland owner issues (WFFA).

At this point you are probably asking yourself, "Ok Patti, where's the intersection of the FPB field tour and Integrated Pest Management?" Well, as I shared with the FPB members, we small forestland owners will be damned if "they" do and we will be damned if "they" don't. "They" are the U.S. Forest Service, which manages significant forestland holdings in eastern Washington. The Colville National Forest encompasses 1.1 million acres in northeast Washington; not quite as much acreage as the 55,000 family forestland owners in eastern Washington, who own 1.6 million acres, but very big nonetheless.

The proximity of national forests to eastern Washington rural communities is the impetus for bringing together

the WDNR and the USFS in a recent Good Neighbor Agreement. At the same time, WDNR has just released its 20-year Strategic Health Plan for eastern Washington to "conduct 1.25 million acres of scientifically sound, landscape-scale, cross-boundary management and restoration treatments in priority watersheds to increase forest and watershed resilience by 2037." Here lies the nexus of Bugs and Crud and Firestorms... Oh My!

If the DNR/USFS agreement starts treating large-scale acreages of overstocked, at-risk forests across the landscape, our local mills will have more timber than they can process in a day, so market prices will go down for small forestland owners (if a logging crew is available), resulting in unfavorable market conditions for small forestland owners (SFLOs) to do any forest health treatments of their own. If the GNA does not result in large landscape restoration projects, then SFLOs will continue to get all the bugs and crud and firestorms from nearby USFS-managed forests.

This all sounds very dire, right? Here is the call to action for SFLOs in the Northwest. Get out there and pre-commercially thin your forests to healthy, resilient species and stocking. Reduce fuels from your forest by pruning, chipping, masticating or burning piles. Learn all you can from the excellent articles in this edition of *Northwest Woodlands* to improve your forest's resilience to bugs and crud and fire; and stay engaged in your state's governing agencies to promote best practices. ■

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PRESIDENT'S MESSAGE



SANDRA MURDOCK



What is Integrated Pest Management (IPM)?

A good IPM program should consider the lifecycle of the pest and take advantage of all management strategies. Some methods are not cost effective. Some methods could be worse for your forest than the original pest. Some methods work, some do not. Some methods only work if implemented certain times of the year. Some pests are not a threat to your overall forest health and are just an eyesore.

Your pest management program should consider your situation. Successful IPM programs implement all the following: identify your pests and monitor their progress over years, decide what you are willing to tolerate, learn how to prevent the pest in the first place and then research the best control methods. Find out what works and what doesn't, and why. Is your pest native or not?

For example, noxious weeds are on the rise. Noxious weeds can be complicated and the best time to manage them is when they first show up on your land, so pay attention. It's not simple and there are laws saying you should be making an effort. Each weed has its own special characteristics that affect the types of management you can do and when to do it. You need a plan. Management of noxious weeds can't just be left to the elements; most are non-native and can overpower native plants. Your native plants did not evolve with them, and they may have little or no defensive tactic to use against them. This is why an IPM plan for noxious weeds really needs to be well-researched and may involve chem-

icals to be effective. But again, when, what and how much are all questions that research can help you understand. Do your homework and use the resources that are available to you. Here is a place to start: invasivespecies.idaho.gov/noxious-weed-program

Now, let's talk bark beetles. The effects of bark beetles are also on the rise, but it takes a different strategy to deal with them. This is why: bark beetles are native, and our trees have evolved with them. Some tree types are much more susceptible to an attack. Trees that are under stress from overcrowding are more susceptible to attacks. By the time you notice a tree is dead, the beetles have moved on to another tree. You cannot fight bark beetles with pesticides: the tree is too tall and the beetles are under the bark. Just cutting the tree down and using it as firewood does not fix the problem. Maybe your bark beetle issue is only cosmetic. Get yourself educated by reading this handout from IDL on beetles: idl.idaho.gov/forestry/forest-health/bark-beetle-brochure.pdf. ■

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PRESIDENT'S MESSAGE



RICK BARNES



Integrated Pest Management

As I think about Integrated Pest Management (IPM), most answers are already in our current toolbox. Being aware and practicing good, active forest management is the key to most pest issues. IPM relies on a combination of common sense, economical practices and pest control methods, with the least hazard to people, property and the environment.

Be aware of what's going on with

your property. When enjoying a walk, or working on your tree farm, be aware of your surroundings. If you see the beginning of a potential issue, make a mental note and document the location and problem. You will save yourself a tremendous amount of work and money by addressing problems early rather than waiting until they become big issues. It is also important to know the preferred tim-

ing for management activities to get the desired results and the biggest bang for your buck. A few examples may include:

- If you see signs of animal damage, such as by bears or mountain beavers, take care of them promptly before they multiply and hurt your forestry efforts.
- Controlling competing vegetation and noxious weeds before they get completely out of control is crucial. Find out the preferred treatment method and proper time of year for treatment. If using chemicals, treating competing vegetation and noxious weeds at the first opportunity will minimize the amount of chemical used and minimize the effort and cost.

Planning your management activities to avoid the spread of the disease or pest is important. In our specific situation, we have Port Orford cedar root rot. The pathogen is a soil-borne root disease that is spread via water. We are very careful with our activities and management practices in those areas. During the wet months, we take great care to avoid entering the areas affected by the disease. When we harvest the cedar, we replant with root rot-resistant stock or another species suitable for the area.

There are great resources available to keep you apprised of local issues and treatments. If you're not already a member of your Small Woodlands Association, they are very worthwhile organizations to join. The local chapters and the statewide organizations offer educational tours and workshops that are invaluable to small woodland owners addressing a broad range of topics. Another source for information is your Extension Service; they too offer many classes and workshops, and often cooperate with Small Woodland Associations to offer programs.

The bottom line is to be aware of what is happening on your tree farm, seek answers to your questions and take prompt action. You will enjoy your property more if you are diligent in taking care of problems when they are small. ■



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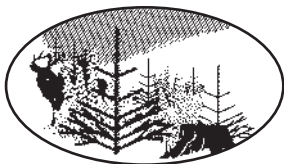
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Down on the Tree Farm

FEBRUARY

- ✓ Register for your association's annual meeting or conference: IFOA, March 26-27; MFOA, April 27; WFFA, May 20-22; and OSWA, June 23-25. They are one of the best benefits of membership—an opportunity to exchange success stories and challenges with your fellow forestland owners.
- ✓ Clean out and repair your bird boxes and perches; install new ones wherever you've seen recent activity. Raptors would appreciate a handy perch adjacent to your mouse, vole or ground squirrel activity!
- ✓ Assemble pertinent tax records and prepare your return. If you are lucky enough to have an accountant or tax preparer, take your paperwork to them early.
- ✓ Research integrated pest management options for invasive plants or insect/disease issues on your forestland. Pesticides are sometimes the best solution, but they're not the only solution. Consult with your tree farm contacts for treatments that have been successful. Whenever possible, practice prevention.
- ✓ Where there is potential for pine engraver beetles to enter your thinning slash, complete your precommercial thinning early in the year so the slash has time to dry before the first flight.
- ✓ Tour your proposed logging operation with your forester and logger. Rely on their experience and good reputation to conduct a successful operation. Develop a solid contract and time your operation carefully. Take the responsibility to assure that your logger has all appropriate fire equipment in good working order.

FOR MORE INFORMATION...

check out these favorite websites and publications:

- wdfw.wa.gov/living/projects/nestboxes
- uidaho.edu/extension/ipm (integrated pest management)
- fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5187526.pdf (pine engraver)
- extension.oregonstate.edu/sorec/sites/default/files/reader-spreads-keep_you_home_safe_from_wildfire_web-res.pdf (fuel reduction)
- knowyourforest.org/learning-library/logging-and-selling-timber
- timbertax.org
- forestseedlingnetwork.com/media/15903/Selecting_and_Buying_Quality_Seedlings.pdf
- cfpub.epa.gov/surf/locate/index.cfm (Surf Your Watershed)
- ext.wsu.edu/documents/StormDamage.pdf
- [Plant%20Your%20Seedlings%20Right%20a.pdf](#)

MARCH

- ✓ Begin tree planting in higher elevation units this month. Avoid planting in frosty soils and protect your bare root seedlings from freezing. Finish well before the moisture is gone from the soil.
- ✓ Complete fuel reduction projects around your structures and in your forest. Don't forget the outbuildings, public and private access roads, and that precommercial thinning project you just completed!
- ✓ Order seedlings for 2018 reforestation projects. Make sure your seedlings match your site.
- ✓ Install seedling protection measures before the tasty buds have opened.
- ✓ If you're pruning to improve aesthetics, log value or to remove ladder fuels, finish before sap begins to flow to minimize bark damage and insect activity.
- ✓ Survey nesting sites to record activity. Keep a sharp eye out for adults and sensitive young.
- ✓ Take some time to evaluate your riparian buffers and wetlands and how they enhance the local habitat and connectivity. How does your forestland contribute to the larger watershed?

APRIL

- ✓ Survey winter storm damage and plan for salvage and/or repair.
- ✓ Finish cutting firewood before fuels dry out to minimize the potential for wildfire. Spreading the cut wood on the ground will allow it to dry before collection.
- ✓ Plan for fire season: meet with neighbors, ask your fire protection agency for a courtesy inspection, prepare equipment, move firewood away from your house and assure adequate access for engines. Make sure your family members know what to do in the event of a fire. You are an important part of the fire prevention solution.
- ✓ Develop a recreation plan and get the family involved in clearing trails and camping/fishing spots. Then take some time to just enjoy your property.
- ✓ Monitor your 2017 projects and update your photo points. Plan a tour for fellow forestland owners to share your accomplishments. You deserve a pat on the back from people who know!

Down on the Tree Farm is a compilation of all of the excellent tips contributed to this column by experienced volunteers over the last 16 years. Suggestions are always welcome and may be sent to the editor at: annewithnwn@gmail.com.

Integrated Pest Management in Forestry: See the Forest *and* the Trees

By **CHRISTINE BUHL**

Many of us are quite familiar with the term integrated pest management (IPM), but do we recognize all of its components? And further, are we utilizing these components in our woodlands? IPM is a multifaceted strategy that has been widely used in agriculture for the prevention and mitigation of pest injury, but should not be limited to the agricultural setting. And just as IPM may be applied to many different systems, it is not limited to insect pests, but may also be utilized to manage other stressors, such as vertebrate pests, abiotic damage, diseases and noxious weeds. This article will review IPM in the scope of insect pests, but also touch on management strategies for other types of forest pests.

In forestry, many insect pests are secondary, meaning they attack already stressed trees. The need to take into account the primary cause of these secondary stressors requires a more comprehensive monitoring and management regiment, which is the



central idea of IPM, to “see” the forest *and* the trees. Time is also a major factor in an integrated approach. It is tempting to make management decisions based on current conditions, but forest crops have a longer rotation than most agricultural crops, and management actions rely on projections of future conditions. Log prices and climate change are just two examples of highly influential predictors that guide long-term management planning.

IPM review

IPM grew out of the Rachael Carson “*Silent Spring*”-era in the 1950’s where concern for indiscriminant use and cascade effects of pesticides came to a head. This holistic approach to pest management sought to reduce our overreliance on a single strategy, which in many cases was chemical control.

The practice of IPM does not exclude chemical control (it is included as a pest management tool), but instead provides additional management options. Having other tools in addition to or in place of chemical control can potentially reduce labor and costs as well as negative effects from the overuse of pesticides, such as

resistance factors and impacts to non-targets. As part of its comprehensive approach, IPM focuses more on management of the whole versus control of the parts. This ethos focuses heavily on monitoring and observation of pests and their damage within a framework of pre-established thresholds for when actions should take place, as opposed to indiscriminant or systematic calendar treatments.

Management objectives of the past often focused on complete control and eradication of pests. This has shifted to a more realistic reduction of injury to tolerable levels. Pest management strategies have evolved since the inception of IPM and continue to improve as we learn more about our forested systems and as new silvicultural tools are introduced. Finding tools that are more selective to address specific pests while simultaneously accounting for the larger system and improving compatibility with ecological principals is daunting, but in the end, provides more sustainable solutions.

IPM components

A complete IPM program consists of: a) setting action thresholds before control is needed, b) ongoing moni-



Non-managed (left) and intensively managed (right) pine stands.

PHOTO COURTESY: CHRISTINE BUHL

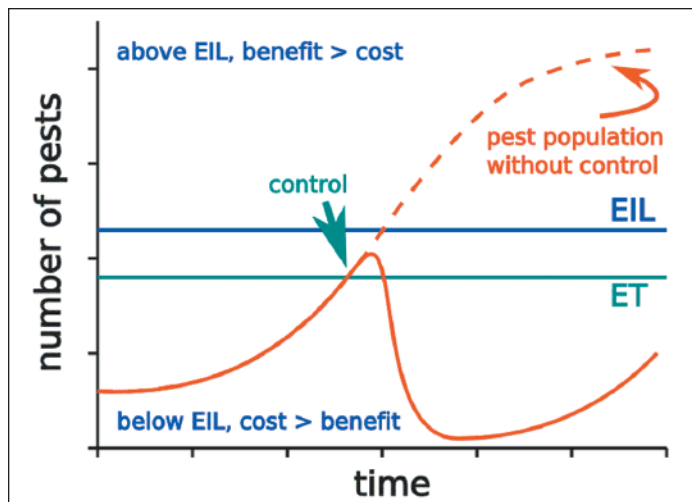
toring to properly evaluate pest/injury levels, c) preventive actions, and d) control if or when necessary.

Set action thresholds.

Financial costs are often the primary driving factor for management and are influenced by the amount or intensity of injury. This relationship is used to determine if and when to carry out control measures and is termed the economic injury level (EIL) concept, introduced by Stern et. al., in 1959. The EIL concept has been refined over time, but helps determine when economic damage (level of injury that actually causes loss) justifies the costs of control. Metrics in this assessment are the amount of injury and time, wherein number of pests is usually measured in place of amount of injury because they are easier to quantify, and they correlate well with amount of injury. The amount of injury that results in losses equal to the costs of control is the EIL. Control measures are often triggered at a point before EIL called the economic threshold (ET), when control is still cost-effective. Once these action threshold parameters are set up, it is easier to make go/no-go decisions. Options then are to:

- 1) Do nothing. Pests may be at or below tolerable levels, or the fiscal, labor and/or ecological costs outweigh the benefits of management.
- 2) Reduce pest numbers. Passive or direct control of pests to reduce reproductive or survival potentials, or change the environment to lower the carrying capacity of pest populations.
- 3) Reduce crop susceptibility to injury from pests. Improved crop resilience, selection for more resistant varieties, physical protection of the crop itself and similar options.
- 4) Attempt 2 and 3.

Monitoring. The goal of control measures is not just to kill pests; it is



When pest levels are high enough to cause injury that calls for control, the economic threshold (ET) is met. If control is not triggered at this point, pest levels may surpass the economic injury level (EIL) wherein control is no longer cost-effective.

to prevent or reduce their status as pests, which is determined by the level of injury they inflict. A consistent monitoring program will help estab-

lish a baseline for endemic pest levels and project a range at which populations can cause injury or damage (i.e., loss). Having this historical record can also provide documentation with which to predict future thresholds at the onset of population peaks or determine acceptable injury levels. As mentioned, injury levels are often measured by estimating the pest population, but variables besides number of individuals impact amount of damage in time and space. Pest intensity can be occasional or reoccurring and, at each instance, mild or severe; or sub-economic, in

—Continued on next page—



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which damage is occasional, but may prove costly when calculated cumulatively over the life of a crop. Other factors that influence accounting for injury include timing of injury (e.g., relative to the season, age of plant or tissue), part of the plant that was injured or the type and intensity of injury. These factors must be accounted for when deciding what to observe during monitoring.

Prevention. Control measures for many forest pests are out of reach because they are: not cost-effective, laborious to apply, impossible to apply evenly due to lack of access, or simply do not exist yet. For these pests we can only rely on preventive measures. A perfect example is management of native bark beetles, one of the primary pests in Pacific Northwest forests. Native bark beetles are ever-present throughout forest stands. At endemic levels they are components of a healthy ecosystem and, although controversial, could be considered beneficial by removing less vigorous trees. Healthy trees are well-adapted to these beetles and able to defend themselves using a variety of mechanical and chemical defenses.

The primary defense in trees is pitch, which physically pushes out and/or drowns bark beetles upon



PHOTO COURTESY: CHRISTINE BUHL

Barrier treatments can trap or prevent pest entry.

entry, and contains various repellant or toxic compounds aimed at beetles or the fungi they carry. If these defenses are weakened, beetles can overcome trees. And if conditions are right, beetle populations may increase to outbreak levels, at which point the sheer number of beetles can overwhelm well-defended trees. It is tempting to want to treat for the bark beetles themselves, but the primary cause of this attack is decreased tree resiliency. This reduced resiliency may

come in many forms, such as prior abiotic damage (e.g., fire, drought, storms), human-caused mechanical injury, disease or other insect damage, poor tree genetics, poor establishment or unsuitable site quality.

In many cases, if preventive measures took place, trees would be resilient enough to withstand beetle attack and their populations would not rise above thresholds. For forest insect pests, it is imperative to monitor major pests on the landscape and enlist preventive management tools to avoid conditions that may feed an

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outbreak or to mitigate losses should an outbreak occur.

Control. If thresholds are reached, one or more management strategies may be applied. Sources differ in the division of IPM components and they often overlap, but IPM generally includes physical/mechanical, cultural, biological and chemical control strategies. Some of the more common tools within each category that are used in forestry are detailed below.

• **Physical and mechanical.** Physical and mechanical control are sometimes separated, but have the same objective: removing or killing pests or preventing pests from reaching hosts using human labor or equipment. Landscape level physical or mechanical removal of many pests, such as insects, is neither possible nor advised, although insects may be blocked from trees using traps or barriers. More often, populations are reduced by removing infested trees or destroying slash. Various pathogens, such as mistletoe or gall infections, may be physically destroyed to sanitize sites, and noxious weeds can be depressed via repeated mowing when plants are actively growing.

• **Cultural.** Forest management, from planting to precommercial thinning to harvest, is full of opportunities for cultural control techniques. Stand composition in terms of species, age class and spacing can be altered to avoid creating the preferred environment for a pest to flourish. The term “cultural control” is broad and can entail many different scenarios. Switching to a non-host species in a root rot pocket can reduce on-site residence time of a pathogen.

Increasing planting density in weevil-prone areas will encourage upward growth, rather than outward, bushy growth that often results from weevil attacks. Stand rotation time can be shortened to reduce the number of older, less vigorous trees that are more susceptible to bark beetles. Making a practice of limiting damage to leave trees during management or harvest activities can avoid unneces-

sary re-entry. Widen equipment paths, perform activities when conditions pose less risk for root compaction, and remove trees scraped by equipment or scorched during burning.

Sometimes strategies may seem counterintuitive, but are successful in some scenarios. For example, the objective for many conifer stands is to thin from below to remove suppressed trees and keep large, vigorous trees for future harvest. However, some bark beetles prefer large-diameter trees and will seek those out first. Where these beetles pose a chronic risk, it may be beneficial to instead thin from above to remove these attractive large trees and allow smaller trees to dominate the stand, provided that these trees are healthy and have the potential to thrive.

In another example, fertilization may be used to improve growth of trees that seem less vigorous due to poor growing conditions or drought.

Although increased fertility would indeed increase growth, it would also increase water demands and therefore add stress to an already struggling tree.

Tree genetics is a foundationally important cultural management tool. Some cultivars are phenologically mismatched with their major pests and discourage attack. For example, seed set may occur before a major seed pest reaches the developmental stage where it is ready to seek out and attack hosts. Different cultivars have also been bred for a variety of resistance and tolerance defenses. However, care must be taken when utilizing cultivars from outside the intended growing zone. Despite the potential for increased defense or other enhanced qualities, trees that are not derived from local genomic stock may have poorer growth relative to their more susceptible, but also more vigorous,

—Continued on next page—

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local counterparts.

The stand environment can also be altered to lower the carrying capacity of pests, reduce reproductive or survival potentials, or disrupt travel. For example, bark beetles are attracted to volatiles given off by trees, as well as pheromones from potential mates. Opening a stand through thinning not only reduces tree competition for resources, such as water, but also increases airflow through the stand, which disperses these attractive smells and promotes better distribution of bark beetles on the landscape.

Increasing the spacing of trees or reducing the number of canopy layers can reduce the ability of some caterpillar larvae to travel from canopy to canopy. Transport of water or soil-borne spores and seeds from noxious weeds can be avoided by using bridges over waterways, removing hosts downstream, washing equipment and other prevention measures.



PHOTO COURTESY: CHRISTINE BUHL

MCH anti-aggregation pheromone synthesized and used to repel Douglas-fir and spruce bark beetles.

• **Biological.** This method of control uses nature against itself. Biocontrol uses natural enemies to control a pest in one of three ways: introduction of natural enemies of the pest (classical biocontrol), mass-breeding and dispersal of local natural enemies (augmentation) and promotion of wild natural enemies and their habitats (conservation). Predators, parasitoids, competitors



PHOTO COURTESY: CHRISTINE BUHL

Management of slash during operations is particularly important in pine-dominated stands to avoid buildup of Ips bark beetles.

and pathogens are all potential natural enemies. Pheromones are a tool used by insects for species-to-species communication to find hosts and mates or prevent overcrowding. Some of these pheromones have been isolated and synthesized to repel pests or disrupt mating. Another method of biological control is the use of sterile male insects. The release of sterile individuals can reduce the number of successful mating attempts and thereby reduce the number of offspring.

• **Chemical.** Organochlorides, such as DDT, have long residence times in the environment and may bioaccumulate. They are being phased out globally, but are mentioned here due to their role in eliciting investigations of pesticide use and the need for IPM. Organophosphates became the next generation of pesticides and are still actively used despite the potential risk to humans and wildlife. Various other categories of biologically derived and synthetic chemicals, such as carbamates, pyrethroids, pyrethrins and neonicotinoids are also widely utilized for chemical control. Biopesticides that occur in some form in the environment, such as *Bacillus thuringiensis* or Bt, nucleopolyhedrosis virus or NPV, spinosad, neem, fungal sprays, growth regulators or hormone mim-

ics, are also classified as chemical controls. No matter the source, these controls should be applied judiciously. Products should be as selective as possible, applied as needed at the right time in pest growth or development, and isolated to the treatment area to minimize drift. Following label rates and alternating products with different modes of action can further reduce the potential for resistance.

Examples of IPM in forestry

Nurseries and seed orchards can be stressful environments for trees due to unnatural growing conditions and destructive methods for inducing seed. In addition, natural enemies tend to be depressed around areas of intensively managed crops due to lack of habitat, fluctuation of prey populations and drift from broad-spectrum pesticides. These sites are monitored frequently, easy to access, uniform and easier to control than natural settings and therefore are excellent for utilizing IPM. Methods used for prevention and control may include sanitation of overwintering sites (e.g., duff, dropped needles or cones), sprays applied at the correct time of year and insect development (using emergence traps and degree-day models), exclusion barriers and traps (e.g.,

bagged cones, Tanglefoot®).

There are some insects that readily come to baited traps, such as western spruce budworm, Douglas-fir tussock moth and gypsy moth. These traps are used for early detection monitoring to indicate if a novel insect is found in an area or if endemic populations are building toward an outbreak. If traps indicate populations have climbed above an established threshold, a follow-up may include monitoring for larvae or utilizing models to pinpoint timing for chemical application.

In the natural forest setting, monitoring the entire stand is often impossible and treatment is expensive, but preventive measures may be taken all along the way to ensure pest populations do not rise above threshold levels. As mentioned, many pests attack stressed trees, so ensuring the health of a tree is central to long-term resilience.

- Cultural control may be used in the beginning of a tree's life with selection of genomic stock. Are seeds or seedlings derived from genetic stock that is local to the planting area or suited to the microclimate of the site?

- Account for chronic pest issues on the site, such as adelgid or root rot, when selecting species or cultivars to plant.

- Is the species or cultivar being planted in an appropriate site in terms of current and future soil quality, exposure to sun and wind, and access to adequate precipitation from groundwater, snowmelt or rain?

- Are trees sufficiently spaced and planted properly to allow root and crown spread before initial entry?

- Physical barriers and traps can protect trees from vertebrate damage.

- The addition of mulch or non-aggressive groundcover in smaller plantings can assist with moisture retention.

- What spacing is right for the species, site, current and projected environmental conditions, and time-frame for re-entry? There are many unknowns in this area that determine management strategies and timing, such as access to the site, forest prac-

tices requirements, and log and pulp prices. Management of slash materials that attract insect pests and add to fuel loads must also be accounted for in thinning and harvest activities.

- Chemical control that uses herbicides can guarantee tree establishment by allowing it room to grow and access to enough moisture and sunlight.

- At harvest, IPM should still be used to prevent attacks from insects and pathogens that reduce structural or cosmetic value. Processing logs quickly can prevent attack from these secondary pests.

When I am called out to assess declining trees, it is rare to find one issue and provide the landowner or manager with a silver bullet solution. There is often a combination of abiotic, insect and disease issues at play, but by mitigating the primary tree stressor we can selectively prevent secondary impacts. Sometimes the problem is bigger than addressing a

primary pest: it is the stand conditions or suitability of the site. Although it seems easier to simply provide a treatment for the latest stressor, that treatment is often not a lasting solution. Having a management plan that includes IPM strategies not only takes the guesswork out of decision-making, but can reduce future losses to pests. More information is available at: tinyurl.com/ODF-ForestHealth. ■

CHRISTINE BUHL *has worked in forest, agricultural, aquatic, tropical and urban entomology across the country for the past 15 years. She studied at Oregon State University (B.S. 2003) and University of Wisconsin-Madison (Ph.D. 2013). Since 2015 she has served as the forest entomologist for the Oregon Department of Forestry, providing technical assistance to public and private landowners across the state. She can be reached at christine.j.buhl@oregon.gov.*



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Successful Pesticide Applications in the Forest

By **THOMAS WHITTINGTON**

The choice to use pesticides on forestland should be part of an overall management plan and strategy that helps the forest manager achieve their goals and objectives. If the manager chooses pesticides to control undesirable vegetation or species, it is vital that the landowner and applicator follow best management practices (BMPs). Adhering to the following BMPs is critical because of the intense focus on pesticide use in forestry.



Forest managers often base pesticide use on economics and how it can help re-grow forests quickly for their many benefits. Pacific Northwest forests are often rugged and remote. In this environment, pesticide use can provide a low-cost option for boosting early forest growth and controlling vegetation, as compared to manual or biological pest control methods. Pesticides are only a part of the overall forest management strategy.



PHOTO COURTESY: BRUCE KELSAS, HELENA CHEMICAL

*Helicopters are typically used to apply herbicides for control of competing vegetation, but are also handy for application of *Bacillus thuringiensis* (or Bt) as a biological control in integrated pest management. Bt is a natural occurring, soil-borne bacteria that has been used since the 1950s for natural insect control.*

When selecting a pesticide, the BMP calls for the least toxic and narrowest spectrum pesticide for use at the lowest application rate necessary to achieve the goal.

Compared to other uses, forestry pesticide use is typically infrequent and applied in smaller quantities. For

instance, Oregon forestland owners use only four percent of all pesticides applied in the state, by weight, each year.

Most pesticides used on forestland are herbicides, applied to control unwanted weeds and brush while preparing a site for reforestation or controlling invasive species. Due to the forest environment being a dynamic place, when chemicals are applied it is important to understand pesticide properties and the processes that will begin to occur once introduced to the environment. Chemical behaviors vary depending on properties, such as melting point and vapor pressure. Anyone using pesticides should have a basic understanding of these principles to avoid undesirable effects and achieve effective control of the target pests.

For forestry applications, even though fewer applications occur per site, applicators should always reduce the risks of contaminating water. Protecting water quality includes:

- Choosing mixing sites away from water

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- Ensuring proper buffer widths around bodies of water
- Using drift-reducing agents and the right drop size to improve accuracy

Project planning

Variables to consider when planning the pesticide application are:

Weather. Consider temperature, relative humidity, wind speed, wind direction, atmospheric temperature inversions and precipitation. These may strongly affect the deposition and drift of chemicals, especially during aerial and pressurized, ground-based chemical applications. Pesticide product labels may include specific requirements for weather conditions during applications. There may not be specific forest regulations that control weather limitations; however, most require the weather during the application to be closely monitored and evaluated to ensure chemicals do not drift out of the target area.

Soil. Evaluate the soil properties in your application area. The soil properties will influence how the pesticide behaves and affects the target species. Although the interactions between soil and the pesticide are complex, considering such properties as soil pH, water content and temperature will help you select the proper formu-

lation and application rate.

Timing. Some herbicides work properly only if you apply them to the bare soil before planting. Other herbicides are applied after planting, but at a specific stage of growth. For example, some herbicides only prevent weed seed from emerging, while others kill existing plants and have little impact on germinating seeds. The proper time to apply an herbicide is stated on the label instructions.

Certification. Consult and review the restricted pesticide products list provided by the certification systems (FSC and SFI). Compare the list with the selected product formula to avoid invalidating a certification.

Mapping. Ensure that treatment areas are accurately mapped, and the boundaries are marked or easy to identify. Mapping the areas in need of control will help ensure success and help with the decision on product formulation, application method and rate. The mapping records for the application are vital documentation and will help monitor long-term effectiveness.

Licensing and contracting. When hiring outside help to complete any application, it is essential that their credentials are current and meet the licensing requirements of your state.

Each state has specific requirements for when licensing is required, but in general, anyone applying pesticides should be licensed when treating someone else's property or when using any Restricted Use Products (RUPs). RUPs are not available to the public and may only be applied by a licensed applicator. The EPA (and each state) keeps a list of

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Don't Get Swept Away by Scotch Broom: Using the Best Management Options

By **WENDY DESCAMP**

Originally introduced as an ornamental plant, Scotch broom, *Cytisus scoparius*, is now widespread in western



Washington and Oregon and is a noxious weed in both states along with Idaho and Montana. This invasive plant is a nitrogen-fixing shrub in the legume family (Fabaceae) that is native to much of Europe and the Canary Islands. Mature plants range in size from three to 10 feet in height. Young stems are dark green with ridges, five-angled or star-shaped in cross-section, with upright growth that can resemble a broom. Older stems turn a tan-brown color and become woody and smooth. Leaves toward stem tips are simple and undivided, while lower leaves can be divided into three leaflets. Leaves are deciduous and may drop early in the

summer if the plant is under stress.

Plants begin to flower when they are three years old, but younger plants may flower under the right light and moisture conditions. Flowers are pea-like and yellow, sometimes having red coloring, and bloom in the spring. They occur singly or in pairs in leaf axils and are around one inch in size. Flowers develop seedpods that are up to two inches long, brown-to-black



Scotch broom (Cytisus scoparius) flower and leaves.

color when mature and have hairy margins. The pods contain three to 12 seeds and, when ripe, the pod's two halves audibly split apart, wrapping in alternate directions and catapulting the seeds a short distance. Scotch broom reproduces by seed, with mature plants able to produce more than 8,000 seeds per year. Seeds can germinate over a prolonged period and in a broad temperature range. They have a hard coat and can be viable for many years in the soil, with estimates ranging from five to 30 years or even longer under ideal conditions. This large seedbank of long-lived seeds makes Scotch broom a difficult species to control once it is established.

Though Scotch broom is infamous west of the Cascade Mountains for lining the highways with bright yellow flowers in the spring, it can also be found growing and spreading east of the mountains. Scotch broom grows along forest edges, prairies and grasslands, oak woodlands, coastal areas and disturbed sites, including cleared forestland, burned areas and roadsides. They are more common in open areas, but plants can also survive in low light conditions, such as in a forest understory.

Scotch broom forms aggressive stands that shade out native plants and reduce forage for livestock, elk and deer. It is particularly problematic

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Large infestation of Scotch broom shrubs in bloom.

in our native grassland and open forest habitats. Although seldom grazed, Scotch broom is toxic, especially to horses. The woody biomass increases the risk and intensity of fires. Its seeds can sprout for years after removal and cut stumps can regrow. Scotch broom can change the soil chemistry, making it less suitable for native plants even years after it is removed. Scotch broom also impacts the timber industry, as it rapidly colonizes newly cleared timberland and aggressively competes with tree seedlings.

Control methods

Taking steps to prevent Scotch broom invasions is an important part of a management plan. Monitor areas that may be vulnerable to invasion and control any seedlings and young plants. Areas that experience disturbance, such as from cutting trees or clearing brush, create disturbed conditions that Scotch broom loves to invade given a chance. Do not move soil, gravel or other materials with Scotch broom seeds to new locations.

Because of Scotch broom's high rate of seed production and the longevity of its seedbank, a long-term integrated pest management plan that includes monitoring will be needed for invaded sites. Keep in mind when working with Scotch broom and other invasive species that it is impor-

tant to control seedlings and young plants before they produce seeds if possible. Controlling Scotch broom plants in the fall and winter months could be advantageous, as it would prevent nonnative grasses and forbs

from receiving possible nitrogen inputs from dying plants.

When isolated plants or a small infestation of Scotch broom are present, manual or mechanical control can be effective, followed by seeding or planting desirable species and continuing to monitor and control Scotch broom seedlings as needed. For large infestations, a combination of methods will be needed, targeting outlier plants with mechanical methods and main infestations with biological control, fire, mowing, herbicide use or a combination of these methods. Soil disturbance will result in seed germination from the seedbank, so minimize on-site disturbance. Planting or seeding native plants in areas under restoration is important to provide competition and diversity, as invaded sites can be native seed-limited. Also, establish trees and shrubs to create shade

—Continued on next page—

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PHOTO COURTESY: SAN JUAN COUNTY NOXIOUS WEED CONTROL BOARD

Pulling out a Scotch broom plant with a Weed Wrench tool.

where Scotch broom plants do not prefer growing.

Manual/mechanical. Small- to medium-sized Scotch broom plants can be hand-pulled, making sure to remove the roots. Use a tool like a Weed Wrench, Extractigator or Uprooter to lever plants, along with their roots, out of the ground. When possible, time the removal when soils are moist, as roots will be easier to remove. Hand-pulling small plants will create less soil disturbance than removing the root system of large plants.

Scotch broom plants can resprout after cutting alone. If only cutting or mowing is possible, maximize damage and possible death to the plants by cutting when they are drought-stressed—typically late summer to early fall—cutting plants back to the ground to minimize soil disturbance. Avoid cutting plants during the rainy season when the rate of resprouting will be the highest. This drought-stress cutting method will need to be repeated, ideally before plants produce seed.

Mowing or the cutting back of plants may also need to be done multi-

ple times throughout the growing season if it is not timed for when plants are drought-stressed. Even plants that are just a few months old may have developed large enough roots to recover from one mowing, so repeat mowing or cutting will be needed.

Cultural. Controlled burns can be an excellent method to manage large Scotch broom infestations. Check for state and local restrictions, burn bans or permit requirements before burning. Though plants can resprout after a fire, most fires are hot enough to destroy Scotch broom's cambium, thus killing the plant. One burn alone will not be enough to control the infestation, as new plants will grow. It will take several cycles of prescribed burning to reduce invasions or other control methods will be needed. In the South Puget Sound area, where fire is used to control Scotch broom, prairies are burned every two to three years, as waiting four years between burns will allow plants to go to seed.

To prevent fires from burning too hot and killing native plants, dense stands of Scotch broom may need to be mowed prior to burning. Landowners may not have the option of conducting controlled burns on their land, but mowing or cutting back the Scotch broom and then using a weed torch could be an effective option. Following this approach, resprouting Scotch broom plants or seedlings could be controlled with an herbicide treatment, and then the area could be replanted.

After burning larger infestations, areas may also be heavily seeded with annual grasses or other fast-growing, non-invasive species. The fast-growing plants can effectively crowd out many Scotch broom sprouts. Pull the Scotch broom that does sprout by hand, or use a broadleaf herbicide

that will control the Scotch broom but not desired grasses.

For smaller areas that will be landscaped, mulching, including sheet mulching, or covering the soil after control work, can help reduce or suppress seed germination. Replant the area to provide competition and create shade while continuing to monitor for and remove any seedlings.

Chemical. In general, use herbicides in combination with other control methods to reduce usage. Wherever possible, treat Scotch broom plants before they develop seeds. Herbicide application methods used for Scotch broom include foliar spray, basal bark treatment and cut stump treatment. If using a foliar spray, treat plants when pollinators are not present or are the least active to avoid harm. Cut stump herbicide treatments, where the stem is cut off near its base and the fresh cut is treated, can provide effective control. Basal bark treatment is where the herbicide is applied directly to the bark at the base of the plant. This method, like cut stump treatments, allows targeted herbicide treatments of Scotch broom, with little or no damage to surrounding plants. Herbicide rates for foliar sprays and contact treatments differ, so make sure to check the label for directions.

Depending on the treatment, it may take more than one herbicide application to kill Scotch broom plants. Examples of selective herbicides that can be used to control Scotch broom include those with the active ingredient triclopyr (e.g., Vastlan or Garlon 4 Ultra) or triclopyr combined with aminopyralid (e.g., Capstone). Herbicides with triclopyr are to be used as foliar sprays when plants are rapidly growing. Cut stump and basal bark treatments using these herbicides can occur whenever the ground is not frozen. These selective herbicides typically kill broadleaf plants but do not harm grasses, though there may be exceptions so make sure to check the label. Non-selective herbicides that contain the active ingredients glyphosate

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or imazapyr can be used to control Scotch broom but will also kill any other plants they come in contact with. Application timing varies depending on treatments. Glyphosate should be used as a foliar spray in late summer or early fall, or used in a cut stump treatment in late summer, early fall or during the dormant season. Always read and follow the herbicide label directions carefully for proper dilution rate, surfactant information, application timing and proper sites. For more detailed information on timing and application, contact your county noxious weed board or program, state department of agriculture, extension service or conservation district. Also, check the Pacific Northwest Weed Management Handbook for additional herbicide information available online at: pnwhandbooks.org.

Biological. Biological control agents are available for Scotch broom and can be a valuable management tool for large infestations.

Larvae of the Scotch broom seed weevil, *Exapion fuscirostre*, feed on seeds of Scotch broom in developing seedpods. The adults also feed on flowers and stem tips, though their damage is not significant. The Scotch broom bruchid, *Bruchidius villosus*, larvae feed on developing seeds and impact the plant's reproduction. While these biological control agents will not kill the Scotch broom plants, they will reduce the number of seeds

produced. Use them in the center of large infestations while working to contain infestations and control other isolated plants and populations. Do not release biological control agents in populations that will soon be burned or mowed as they will not have an opportunity to establish on the plants and impact seed production. Check with the Oregon Department of Agriculture's Weed Biological Control Program and Washington State University's Integrated Weed Control Project for information about these biological control agents.

Goats can also help control resprouts after the cutting or burning of Scotch broom. Plant parts are toxic to other livestock though, so only let goats do the grazing. Make sure to protect desired plants from goats as they will be grazed too.

After treatment

There may be an increase of nitrogen-loving, non-native grasses and forbs that grow after Scotch broom removal due to the possible increase of available nitrogen in the soil. Planting and seeding non-invasive plants to outcompete weeds will help reduce the number of new invaders. Newly planted tree seedlings may need some help, as non-native grasses and other weeds may have an initial growth advantage: they are better-adapted to the altered soil nutrients. Native species are adapted to nitrogen-poor soil, so they may not grow

as quickly as non-native invaders. Make sure to watch for and manage new weeds as necessary.

Disposal

Dead or pulled Scotch broom plants may be left in place to decompose, but they could increase soil nitrogen. Plants can be piled to decompose or burn, though again make sure to check on local restrictions, burn bans or permit requirements before burning. Plants without seeds may also be chipped. Local transfer stations or landfills may also be an option for removed plants.

If you have any questions regarding Scotch broom control, contact your local experts such as a noxious weed board or program, state department of agriculture, extension service or conservation district. ■

WENDY DESCAMP is the Education Specialist for the Washington State Noxious Weed Control Board. She can be reached at 360-725-5764 or wdescamp@agr.wa.gov.

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Successful Pesticide Applications

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restricted products, which is updated on a regular basis. The list includes certain active ingredients that are used for vegetation control in the forest environment. All other pesticides are classified as “general use” and may be applied by the public on their own property.

Product selection

Selecting the specific pesticide is a very important step. Consider the individual landowner's or forest manager's goals, circumstances and specific needs to determine the best product for controlling the target species. It is important to fully understand the target species, including its physiology, life cycle and how it interacts with the environment. For example, contact herbicides, which are applied to plant surfaces and kill through contact, may work well for young weeds or annuals, while perennials may need herbicides that move into the roots and keep the plant from regrowing.

It is especially important to complete your research on the differences of selective and non-selective pesticide types before choosing the active ingredients and formulation. When possible, avoid getting broad spectrum (non-selective) pesticides, because they could potentially kill or harm beneficial species as well. If a non-selective pesticide is the only option, try doing spot treatments to reduce the risk of affecting non-target organisms. Having knowledge of the target species will lend itself to the selection of the pesticide product that is best-suited to your forest and situation.

To use an herbicide (or any pesticide) in a manner inconsistent with the label instructions is illegal and can harm trees and other species not intended for control. The pesticide label is the law. To make sure you have the right tool for the job, before purchasing or applying the pesticide,

read the label to determine:

- Safety measures to follow
- Where it can legally be used
- When to apply it
- Pre-harvest conditions
- The rotation interval
- How to apply it
- Use restrictions (e.g., restricted-entry intervals or prohibitions against certain types of application methods or equipment)
- Other restrictions (e.g., environmental conditions, setbacks or buffers, and drift warnings)

Other considerations. Plan to protect your investment and the environment. Avoid buying too much of a pesticide. Over time, a pesticide container may deteriorate and leak, or the label may become illegible or fall off. You can prevent storage and disposal risks by estimating how much herbicide you will use in a reasonable period and buying the proper size. To make your estimate, use three bits of information:

1. The dosage or dilution specified for your treatment site (review the label)
2. The area (square feet or acreage) of the site that you will treat, and
3. How many times a year you will treat the area (some product labels limit the number of treatments to a crop or a site over a period of time).

Pesticides are packaged in a variety of dry and liquid formulations. Determine which formulation best suits your needs by considering the location and any related human, wildlife or environmental elements. Also, consider the application and safety equipment needed to complete the operation.

Ready-to-use products are handier than concentrates that need dilution and mixing. Ready-to-use products often come in containers designed to double as the application device and usually require basic safety equipment. Although they may be more expensive, their convenience may justify the cost.

Again, review your strategy to ensure the target species is controlled

in the most efficient manner. The formulation may also influence a pesticide's selectivity. For example, because granular formulations do not stick to dry foliage, they will not be effective and will increase the chance of affecting non-target species in dry conditions.

Conducting a successful operation

Regulatory requirements. A critical aspect of a successful project is working within your state's regulatory framework for forest pesticide use. The forestry laws and regulations often specify requirements above and beyond the pesticide label. This can include licensing of pesticide applicators, and establishing buffers between the area to be treated and nearby streams, surface water intakes, agricultural lands, residences and sensitive sites.

To ensure the resources are protected, submitting a notification and/or obtaining a permit are crucial steps. Planning ahead and identifying these requirements and regulatory agencies will help complete the notification/permitting process in a timely manner. The information that will be required to provide for the chemical application will include: a detailed map of the treatment area, acreage to be treated, active ingredient(s) with EPA registration number, the type of carrier or adjuvant, method of application and, if known, any protected resources.

Neighbor concerns. It is important to recognize the importance of considering the neighbors in the region that may be impacted by forest activities. Being a responsible manager involves knowing the correct terminology when discussing your work. When speaking with the public, it is better to use simple, direct language than technical terms. Be proactive and reach out to neighbors and others who may have concerns about a nearby sensitive site.

Mixing precautions. Ensure that no tank mixture can back-siphon into a water source. When filling a mix tank

using a water pipe or hose, place the pipe or hose end well above the surface of the pesticide mixture, leaving a distinct air gap between the two. If water is pumped directly from the source into a mix tank, use a check valve, anti-siphoning device or back-flow preventer to avoid back-siphoning if the pump fails. Mix pesticides in areas where any spills, leaks and overflows cannot enter a drain or water source. When selecting locations for mixing and loading, avoid sites that have a direct path to surface or ground water and be sure to adhere to the rules and BMP's in your state. If using a permanent mixing site, use a containment pad or other acceptable mitigation measure and, when possible, locate the site near the application area to minimize exposure and increase efficiency. The mixing site should also have all the documentation for the labels, a decontamination method, record-keeping materials and any required safety/legal postings.

Personal protective equipment (PPE). Before working with pesticides, make sure the needed PPE and the equipment and materials required to safely measure, mix and load are ready to go. Persons working around pesticides should have the proper training and know the rules and regulations that apply to the work setting. Be sure to consult the label for specifics which may include provisions for the worker protection standards that have some additional requirements. Be sure to wear proper PPE when handling pesticide containers, even before opening them. Pesticide handlers must wear all of the PPE that the pesticide labeling requires and may include body, face, respiratory and eye protection.

Record keeping. Keep accurate pesticide application records regardless of whether required by law. Maintaining accurate and complete daily application records demonstrates a forest manager's care and professionalism, and documents the facts of an application, including

who, what, when and where. If there happens to be a complaint or legal action following an application, having complete and accurate records will be valuable. The use of technology has also made record-keeping easier than ever. Embracing technology, including mobile hardware and GPS tracking, make us all more efficient. Record-keeping is now clean, efficient and accessible well into the future. For this aspect of forest management, the recommendation is to utilize the best available technology.

Spill and containment response.

Develop a spill contingency plan that provides for immediate spill containment and cleanup, and notification of proper authorities. If a leak or spill was to occur, it is the responsibility of the operator to contain the leak or clean up the spill immediately.

Clean up. Thoroughly clean equipment and PPE after mixing, loading or applying pesticide products. Do not leave equipment containing pesticides at the mixing and loading or application sites. Ensure proper safety procedures are followed when cleaning the pesticide-contaminated equipment and containers. Equipment cleaning presents as high a risk of pesticide exposure as other pesticide-handling tasks. When cleaning contaminated application gear and equipment, wear the same PPE that the labeling requires for making applications, plus a chemical-resistant apron or other appropriate protective equipment. This is a good time to

record all information about the application, while the facts are still fresh in your mind, to comply with pesticide record-keeping laws.

Remember the label is the law. Not following the label requirements breaks both federal and state law. Forest practice laws also require landowners and operators to take extra steps due to forestry's unique blend of resource protection issues, rugged terrain and operating constraints. In this complex world, a successful pesticide application may be a critical step to help you achieve the goals and objectives of your forest management plan. Success may be measured in many ways, but a common goal of managers is maintaining a healthy, productive forest and the many benefits it provides. ■

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IPM for the Flatheaded Fir Borer: A Major Forest Pest in Southern Oregon

By **MAX BENNETT**

As we drove up a forest road in the Applegate river valley last spring, it was hard to miss: hundreds upon hundreds of mature Douglas-firs with red or gray crowns, the victims of a major outbreak of the flatheaded fir borer (*Phaenops drummondi*). “It’s mayhem!” exclaimed my colleague, a forest pathologist who tends to get excited when he sees dead and dying trees. While flatheaded fir borer (FFB) mortality is chronic in southwest Oregon, especially on warm, dry sites in interior valleys, what we were seeing was unprecedented. More than 120,000 Douglas-fir trees are estimated to have been killed by this insect in Jackson, Josephine, and Douglas Counties in 2016 following the “hot drought” of 2013-2015. This level of mortality has generated widespread concern among landowners and managers throughout the region. How could an integrated pest management (IPM) strategy be applied to this problem?

An unusual wood borer

Most wood borers are secondary insects that infest dying or recently



Recent Douglas-fir mortality due to the FFB, Applegate watershed, southern Oregon.

dead trees, excavate galleries in the wood, and help promote wood decomposition, but don’t kill trees on their own. The FFB is a significant exception. Although technically not a bark beetle, it acts very much like one, attacking green trees and feeding only underneath the bark instead of tunneling into the wood. In the Klamath Mountains ecoregion of southwestern Oregon and northwestern California, the FFB consistently kills green, healthy Douglas-fir, especially on tough sites. This mortality is typically minor in extent but can increase dramatically after drought, as was seen in 2016. It is the most important tree-killing insect pest of Douglas-fir from southern Douglas County to interior northern California. While our focus here is on southern Oregon, it should be noted that the major hosts of the FFB include western larch and true firs, and the insect is widely distributed across North America. A related species, the California flatheaded borer (*Phaenops californica*) infests pine in California.

Monitoring

A typical first step in IPM is to monitor for signs and symptoms of the pest of interest. Unfortunately, detection of FFB infestation in a live tree can be challenging. There are no pitch tubes, frass or boring dust prior to emergence as with bark beetles. The larvae can be hard to find, and infested trees are quickly colonized by other wood borers. Affected trees often have thin or yellowing crowns or branch dieback, but these symptoms can also be caused by other beetles, canker fungi, drought stress, root disease and other agents. Woodpeckers feeding on the overwintering larvae in the outer bark is one sign of probable infestation. Infested trees usually turn red in the spring or early summer in the year following the initial attack. By this time, the FFBs have usually left the tree. In some cases, a tree may be infested for multiple years. Attacks are not always successful, and vigorous trees can drown the beetles in resin.

The annual cooperative USFS/ODF aerial survey documents locations of recent FFB mortality, rang-

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ing from individual trees to multi-acre patches with many dead trees. The survey data can be used to estimate the total number of trees killed and to monitor trends in FFB mortality. Landowners can also use the maps to assess the location of mortality patches on, or in proximity to, their properties. Landowners sometimes mistakenly assume that when a mortality patch is mapped it means all the trees in the patch have been killed, whereas in reality, usually only a few trees per acre have been killed.

Action thresholds

The FFB is a native insect pest that causes some Douglas-fir mortality every year. At what point does this become a problem warranting intervention? Each owner must answer this question based on their land management objectives. Most would tolerate background levels of mortality, but want to avoid, if possible, the loss of many trees that can occur during an outbreak. However, the issue is complicated by environmental changes that have occurred in the region over the past century, as well as climate change.

Historically, the region experienced frequent low- to moderate-severity fire that tended to promote lower stand densities and a higher proportion of pines and oaks than are seen today. Douglas-fir was certainly present but not as abundant at lower elevations, especially on the margins of interior valleys. With the exclusion of fire, Douglas-fir has occupied (some would even say invaded) these sites, sometimes growing in dense stands and outcompeting the oaks and pines. But with increasing temperatures and periodic droughts many low elevations sites have become climatically marginal for Douglas-fir, and the trees have become increasingly vulnerable to stress-related pest problems such as the FFB. From this perspective, the accelerated loss of Douglas-fir to the FFB on marginal sites is inevitable and perhaps even desirable. Not everyone accepts this

interpretation, and for landowners who are losing many valued, and often large, Douglas-fir trees, there is often an interest in holding on to their trees, regardless of the larger ecological context.

Wildfire management issues are also important to consider in this fire-prone region. The loss of Douglas-fir canopy resulting from the FFB infestation often promotes vigorous re-growth of understory vegetation, which serves as ladder fuel, increasing fire intensity. FFB-killed trees become snags, which have important habitat values but also pose a threat to firefighter safety and are a major source of burning embers during a wildfire. When snags decay and fall apart they contribute to surface fuels. Some patches of FFB-killed Douglas-fir have an understory of brush and small trees and look like they will pose quite a serious fuel hazard down the road. This argues for trying to hold on to

intact, low-elevation Douglas-fir stands, even if they are outside the range of historic variability.

Prevention and control strategies

For a pest like the FFB, prevention is the name of the game. There are really no effective control strategies during major outbreaks, but preventative strategies can reduce susceptibility to the insect and resulting mortality.

Preventing or minimizing loss from the FFB first requires identification of sites where Douglas-fir trees are at high risk of infestation. Risk factors include: elevations of less than 3,500 feet, annual precipitation of less than 40 inches, soils with low water availability, and pine-oak habitat types where Douglas-fir has invaded. In short, hot and dry sites. Notably, white oak stands are often very poor Douglas-fir sites in this region. Whereas Douglas-fir often grows under, and eventually overtops and

—Continued on next page—



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kills, neighboring white oaks in the Willamette Valley, in southern Oregon, Douglas-fir may regenerate in the shade of white oaks, but usually dies before it overtops them. White oak stands in this region tend to occur on shallow, rocky or heavy clay soils with low water-holding capacity.

FFB damage also seems to be more common on stand edges and less abundant in stand interiors. The beetle is apparently sun-loving, and its host trees may be under higher stress in more exposed, sunny locations. FFB damage does not seem to be strongly associated with aspect, nor is there a clear relationship between FFB-related mortality and stand density.

Given that the FFB is most successful on harsh sites, a key preventive strategy in mixed species stands is to favor other species on these sites during thinning, such as pines and oaks. This does not mean that all Douglas-fir must be eliminated, but only the most vigorous Douglas-fir trees with healthy crowns and good spacing should be retained. In some naturally regenerated, low elevation Douglas-fir stands with heavy FFB mortality, there are often a few large Douglas-fir



Typical clumped mortality pattern on a stand edge showing dead, recently dead, and currently infested Douglas-fir trees.

PHOTO COURTESY: BILL SCHAUPP/USFS

trees that remain healthy. These trees seem to be associated with deep soils on concave slopes or near streams where more soil moisture is available. This suggests that retaining a few of the most vigorous Douglas-fir trees on these sites can be a viable strategy.

It's well-accepted that thinning to reduce density in pine stands can increase tree vigor and resistance to bark beetle attack. Can thinning in Douglas-fir dominated stands improve resistance to and loss from the FFB? Since Douglas-fir trees growing on harsh sites seem to be preferentially affected, and beetle populations increase dramatically during and after drought, it makes sense that treatments that improve tree water status, such as thinning, should improve resistance and survival. But that doesn't necessarily turn out to be the case. As mentioned above, field experience and aerial sur-

vey data do not show a strong relationship between stand density and FFB mortality. If anything, it seems that FFB mortality can be lower in the interiors of dense, unthinned stands than on the exposed edges of those stands. This may relate to the preference of the beetle for warm, sunny environments in which to breed.

In the Applegate Valley, mortality has been seen in both thinned and unthinned stands. This suggests that thinning is no panacea. Nevertheless, there is evidence that thinning in relatively vigorous stands well in advance of a FFB outbreak can reduce susceptibility to this pest. On the other hand, thinning in dense, stagnating stands on harsh sites during a drought or FFB outbreak may actually

accentuate tree stress and subsequent FFB mortality. To be effective, thinning should retain the healthiest, most vigorous trees in the stand and preferentially remove trees with thin or fading crowns, branch dieback, or mechanical or fire damage.

When planting on high-risk sites, selection of species that are more drought and heat tolerant, such as ponderosa pine, incense cedar and white and black oak will reduce future mortality.

Good tree care practices in general will also help reduce losses to the FFB. These fall under the general heading of "do no harm," and include things like avoiding soil compaction, root damage from trenching or road cuts, and backfilling over the existing soil surface.

There are no chemicals known to be effective on the FFB. Populations of the beetle are naturally regulated



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by native parasitic wasps and by woodpeckers which feed on the larvae. But once trees are infested, there is no way to save them. The idea of removing infested trees before the adult beetles have emerged and spread to nearby trees is appealing, but hard to carry out in practice. First, it can be hard to tell when a tree is infested before the foliage turns red; by then, the beetles are already gone. Quick salvage at this point will not reduce spread, but can capture the value of the tree before it is invaded by other wood borers that degrade wood quality and value.

If potentially infested trees are identified from branch flagging, thin crowns or woodpecker feeding, harvesting them before beetle emergence may help dampen populations and reduce local spread of the insect. But this will probably not have much of an effect during a drought when populations are already high.

While the FFB is probably the single most important agent of Douglas-fir mortality in southern Oregon, other agents are also responsible for branch dieback, topkill and mortality on hot, dry sites, and trees are often affected by more than one of these agents. The most important of these are canker fungi, Douglas-fir engraver, Douglas-fir pole beetle and Douglas-fir twig weevil. Also, periodic severe water stress alone sometimes causes “embolisms” (a blockage of water conducting cells) that results in similar symptoms. Collectively, the FFB and these other agents can be thought of as a Douglas-fir dieback complex that is causing elevated mortality on harsh sites in southern Oregon. This will likely continue and grow even more severe in the future as the climate warms and the area experiences periodic severe droughts.



PHOTO COURTESY: BILL SCHAUPP, USFS

Woodpecker feeding on FFB-infested Douglas-fir. Note the Oregon white oak stand on the right. FFB-related mortality in Douglas-fir is often seen in and adjacent to white oak stands.

Evaluation

Evaluation is the last step in IPM. Did the chosen prevention and control strategies work? Should another approach be tried? Most landowners

will have an intuitive sense of the success of a given strategy with informal observation. Establishing photo points or even plots in treated and nearby untreated areas can make the assessment more rigorous. However, with many possible confounding factors between treated and untreated areas, such as variations in aspect, soil or tree age, it can be hard to quantify the results of management actions. For this reason, ongoing research is needed. Major research is needed to evaluate the effects of different stocking levels and treatments on FFB-caused mortality. ■

MAX BENNETT is the Forestry and Natural Resources Extension agent for Jackson and Josephine Counties. He has worked in southern Oregon since 2000, and has expertise in fuels

reduction, forest protection, and restoration of mixed conifer forests in the Klamath Mountains ecoregion. Max can be reached at 541-776-7371 or max.bennett@oregonstate.edu.



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Take a Look at Past *Northwest Woodlands*' Themes

Northwest Woodlands magazine began publication in July 1985. Take a look at past themes and get a glimpse of future issues.

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The Understory

Measuring Plots in the Woods

This article is adapted from a Tree Topics blog post by Brad Withrow-Robinson, OSU Forestry & Natural Resources Extension agent for Benton, Linn and Polk Counties. Find more at: blogs.oregonstate.edu/treetopics

In many cases, people don't know the density of trees in their woods, making it more difficult to decide if they have enough room for healthy growth or if trees need to be thinned.

If you know what spacing your trees were planted, you may have a fair idea of the density. A spacing of 10 feet by 10 feet is about 440 trees per acre (tpa) and a 12-by-12 is about 300 tpa. Actual spacing can vary quite a bit according to the conditions in the field and experience of the planters. And some seedlings die during establishment, or some other trees may seed in naturally. So, it is worthwhile to go out and get a better idea of what you've got by measuring some plots.

Figure 1.

Plot size	Plot radius	Tree size dbh
1/100-acre	11'9" (11.8')	4.5-7"
1/50-acre	16'7" (16.7')	7-12"
1/20-acre	26'4" (26.3')	13-20"
1/10-acre	37'2" (37.2')	20-30"

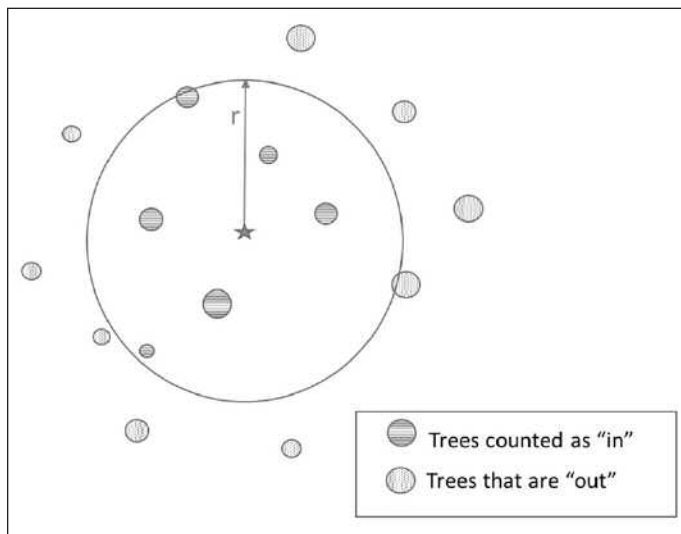
We often use circular plots since they are easy to measure accurately. We choose a radius for the size of the plot we want. We use larger plots for larger trees, smaller plots (and typically more of them) for smaller trees (see Fig. 1).

To practice measuring plots, choose some easy ground with trees that have been pruned up and are not overrun with blackberries. If you don't have anything that fits this description, ask a neighbor or someone in your landowner association.

For this exercise you'll want a few stakes, some flagging, paper, pencil and a tape measure or logger's tape. Oh, and bring a friend along to help.

Go into the woods and pound in several stakes around the stand (each with a piece of flagging). Those will be the centers of your practice plots. Figure out which trees fall within the radius of your plot (e.g., 16.7 feet for a 1/50-acre plot). Some will be easy to tell, others will have to be measured from

Figure 2. In and out.



the plot center. On the line, count a tree as "in" only if the center of the tree is within the radius at breast height (see Fig. 2).

Let's say you count six trees within your 1/50-acre plot, which represents a plot density of 300 tpa. To get that, you multiply your tree count by the denominator of your plot size to get density (6 trees x 50 = 300 tpa). For bonus points, measure the diameter of each of the "in" trees in the plot and record their diameter at breast height (dbh). By figuring the average diameter and combining it with density, you can learn how much competition those trees are contending with. Visit the Tree Topics blog for more information on young stand management: blogs.oregonstate.edu/treetopics.

Accurately measuring a stand requires some rigor, but even a few plots can give you some important insight. So, I'd encourage you to put in some plots and get an eye for what you have. You may want to do a little pruning and clearing in your plots to make it easier, and winter is a great time to do that sort of work.



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TreeSmarts: Answers to Your Tax Planning Questions



▲ *TreeSmarts: Answers to Your Tax Planning Questions* appears every other issue in Northwest Woodlands. The column is edited by John P. Johnston, a partner, CPA, and CMA with Bancroft Buckley Johnston & Serres LLP in Seattle, Washington. He is a member of the AICPA, IMA and WSCPA. Questions can be emailed directly to John at jjohnston@bbjsllp.com.

▲ Pest Damage—Taxable or Deductible?

▲ I recently had a fascinating opportunity to tour forests in the South, New England and Western Europe. I had a million questions and they had even more answers. One common conversation centered around forest damage, whether it be ice and windstorms, routine browse or bugs. That relates directly to questions about revenue recognition, tax deductions and the timing of each. Since you and/or your personnel are top-notch foresters, you catch infestations early. When the bugs are detected, you plan and cut out a large area, treat to the extent possi-

ble, increase your monitoring and hope for the best. The salvage then gets sold into an unknown market. You're hoping it's enough to cover the logging, hauling, and other costs and leave enough left over to replant properly. So, all of this gives rise to both cash in and cash out, and questions about how it will all be treated for tax.

The Internal Revenue Code (IRC) provides some level of relief when you are forced to convert (i.e., sell) your property due to destruction (in whole or in part), theft, seizure, requisition, or sale made under threat of requisition, such as the government exercising its powers of eminent domain. This situation is referred to in IRC §1033 as an *involuntary conversion*, and can be an extremely useful election when needed. In short, it functions similarly to a *like-kind exchange* or *IRC §1031 exchange*. Reinvesting the proceeds in like-kind or similar use property can defer tax until you harvest or sell the new property in the future.

More specifically, you have two

years from the end of the tax year in which the involuntary conversion occurred to reinvest the proceeds in new property (certain circumstances allow extended replacement periods of three to five years). If you need more time than this, you may appeal to the IRS, which has the discretionary authority to grant an extension, but extensions are not always easy to come by, so you're best off meeting the two-year window if you can. Also, since the two years begins at the end of the first tax year, and the involuntary conversion happened at some point during that year, the window is effectively longer than two years by the amount of time between conversion and year end.

As mentioned above, the property must be like-kind or similar in use, and for the purposes of IRC §1033, like-kind is defined fairly liberally. For example, a conservation easement was deemed like-kind to timberland, and a thirty-five-year land lease was like-kind to improved real estate. So, for a damaged tree farm you have several options for replacement. This can get tricky, so discuss your options with your tax advisor before making any plans.



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After you've suffered an involuntary conversion, made your IRC §1033 election and purchased your replacement property, how and when will you eventually recognize gain and incur a tax obligation? Your new property is assigned the tax attributes of the property converted: its basis is that of the original asset, as is its holding period. Therefore, if you had purchased the trees for \$100,000, salvaged them for a net \$300,000, and bought new trees for \$300,000, the future harvest of those new trees would start triggering gain once your sales price exceeds \$100,000.

There is also some tax planning that can be done to make sure you can make the most of an IRC §1033 election. Landowners and foresters usually think about their timberland as several different stands, tracking performance and profitability on a unit by unit basis. However, for tax purposes, it can be beneficial to apply the principles of block accounting. Block accounting considers the holdings as one large block, rather than several smaller tracts. In fact, the parcels need not be contiguous, or even in the same state! What is more important is that your accounting and reporting be done consistently in line with your defined block.

But why would I want to lump everything into one block? Well, there can be many advantages ranging from preferred timber tax calculations (not just for IRC §1033) to simplicity. On the other hand, the pooling effect that block accounting achieves can be confusing and, in some instances, reduce your options. My observation is that the benefits usually outweigh the

drawbacks. Every situation is different so reviewing this with your advisor would be wise.

This is just one planning opportunity with involuntary conversions. If you have business assets, such as a tree farm, plan for the tax impacts of your trees being damaged. And, if you're in the unfortunate position of suffering such damage, an hour or two talking with your tax advisor could really yield some savings, and

allow you to reinvest in your tree farm rather than sending your cash to the government. ■

Send in Your Tax Question

Do you have a question that relates to accounting, business, or tax planning? If so, send it to tax expert John Johnston (jjohnston@bbjsllp.com) and he will answer it in the next scheduled column.

You know how to read a 90 year old log... but can you read the 90 year old tax law?

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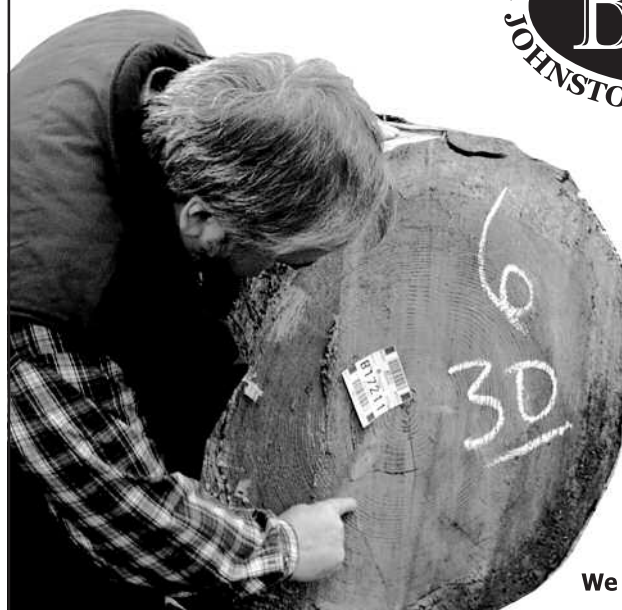
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Tips From The Treeman



▲ **DEAR TREEMAN,** Log prices have been pretty good this year. I had a purchase order with a local mill that I thought was a fair price, but after speaking with a large contractor here I saw that they were getting more money. I know there can be quality differences, but after looking further into it, I found they consistently got more money than some of us private owners. So, what's the deal? —*Raw Deal*

▲ **DEAR RAW DEAL,** You bring up a couple issues for our readers. First is value: a tree may be a tree, may be a tree, but a value may not be a value, or a perceived fair value. You are a small woodland owner, and everything about a harvest operation on your land is small: small volumes to you and relatively small interest to potential contractors, truckers and buyers.

▲ One at a time, but first the obvious. For logging contractors and truckers, bigger is better at least in terms of volumes. More trees to harvest correlates to lower fixed costs per unit and less down time between jobs. There is no escaping a basic concept of economics.

▲ But, on the other hand, just because you have fewer than others (trees), yours is just as good as anyone else, yes? No. The Equal Protection Clause of our Constitution does not pertain to price negotiations: you are now in the business world of caveat venditor. And some things are beyond your control regardless of your level of awareness.

▲ Log buyers, or any commodity buyers, desire a continuous flow of material of consistent quality. Small owners are inconsistent in their delivery of logs with relatively consistent

variability in lengths, diameters and quality—small volumes of wood coming from big geographical areas. Selling a few loads of logs takes less time to process at the mill than it does the buyer to pay you a visit.

Some buyers adjust their prices based on the aforementioned issues. A contractor or consultant consistently and continually supplying logs to a mill may well receive preferential treatment at the negotiating table. C'est la vie.

What to do, what to do? Why not combine the interests of numerous landowners, become partners in negotiations and "strike" for a better deal (i.e., form a co-op)? Co-ops have been in existence for years, performing with a high variability of success. The closer a member's product is to the consumer, the better the chance of success. A good example is firewood; chop down the tree (utilize raw material), cut and split the wood (manufacturing process) and sell it to Harry Homeowner (final consumer). This is an example of the entire marketing process, start-to-finish.

Logs are "birds" of a different feather. Members could buy a portable sawmill, move from owner to owner processing the logs, then sell the lumber to the general public. But the logistics of such an enterprise, maintaining a consistent cash flow, coupled with a continuous flow of material of consistent quality, makes for a high hurdle indeed. So, we're back to trees/logs.

Combine your trees, hire a logger to perform the harvest, negotiate a



Steve Bowers

higher price for larger volumes and we're off to the races. But, we best put that checkered flag on hold—for several reasons. As a member, do you want to subsidize another member with your better-quality material? Maybe. Will you supply more wood than others, thus have a bigger dog in the fight? Questionable.

Log values are cyclical in nature. Generally, prices rise during the wet months (access is the primary issue) and decline when things dry out (supply and demand becoming the problem). Let's give members the benefit of the doubt and say that they indeed negotiate for a better price. Keep in mind the typical purchase order lasts 30 days. We've all these members with trees to harvest in a month. When things dry out, and member "A" is the first to log their property, there is a strong possibility log values will be higher than when member "P" logs in August. Will one of you share your increased value with the less fortunate member who was unable to harvest before prices fell? Problematic at best.

Remember our logging contractors—they like lots of wood in one place. Are members with larger volumes willing to subsidize those less fortunate? Trucking distances to the mill varies for each member—will this give-and-take continue? A storm may be gathering on the horizon.

Consider the myriad logistics of a timber harvest with the character traits of the co-op's members. Private woodland landowners tend to be an independent bunch. Most acquired their holdings through hard work, perseverance and fortitude—with the benefits of those traits not something to be easily surrendered, or shared. In the end, it's pretty much every man or woman for themselves.

Alas, it's a cold cruel world out there—at least in terms of conducting a timber harvest. And it will quite likely be colder and crueler for the little guy. Indeed, life is not fair. Get used to it. That's what Bill Gates says anyway, and we concur. But being a member of the private woodland owners in our region is a glorious thing, 'cause if it wasn't, you wouldn't be here tolerating Treeman. —*Treeman*



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